WHAT IS CLAIMED IS:

1. An apparatus for measuring blood oxygenation in a subject, said apparatus comprising:

a first signal source which applies a first input signal during a first time interval;

a second signal source which applies a second input signal during a second time interval;

a detector which detects a first parametric signal responsive to said first input signal passing through a portion of said subject having blood therein and which detects a second parametric signal responsive to said second input signal passing through said portion of said subject, said detector generating a detector output signal responsive to said first and second parametric signals; and

a signal processor which receives said detector output signal, said signal processor demodulating said detector output signal by applying a first demodulation signal to a signal responsive to said detector output signal to generate a first output signal responsive to said first parametric signal and applying a second demodulation signal to said signal responsive to said detector output signal to generate a second output signal responsive to said second parametric signal, each of said first demodulation signal and said second demodulation signal comprising at least a first component having a first frequency and a first amplitude and a second component having a second frequency and a second amplitude, said second frequency being a harmonic of said first frequency, said second amplitude selected to be related to said first amplitude to minimize crosstalk from said first parametric signal to said second output signal and to minimize crosstalk from said second parametric signal to said first output signal.

2. The method of Claim 1, wherein the second amplitude is determined by turning off one of the first and second signal sources and measuring the crosstalk between one of the parametric signals and the non-corresponding output signal while varying the second amplitude and selecting a second amplitude which minimizes the measured crosstalk.

3. A method of minimizing crosstalk between two signals generated by applying a first pulse and a second pulse to measure a parameter, wherein said first pulse and said second pulse are applied periodically at a first repetition rate defining a period, and wherein said first pulse is generated during a first interval in each period and said second pulse is generated during a second interval in each period, said second interval spaced apart from said first interval, said first and second pulses producing first and second parametric signals responsive to said parameter, said first and second parametric signals being received by a single detector which outputs a composite signal responsive to said first and second parametric signals, said method comprising the steps of:

applying a first demodulation signal to said composite signal to generate a first demodulated output signal, said first demodulation signal comprising at least a first component having a first frequency corresponding to said first repetition rate and having a first amplitude, said first demodulation signal further comprising a second component having a second frequency which is a harmonic of said first frequency and having a second amplitude which has a selected proportional relationship to said first amplitude;

applying a second demodulation signal to said composite signal to generate a second demodulated output signal, said second demodulation signal comprising said first component at said first frequency and said first amplitude and comprising said second component at said second frequency and said second amplitude, at least one of said first and second components of said second demodulation signal having a selected phase difference with respect to the corresponding one of said first and second components of said first demodulation signal; and

lowpass filtering said first demodulated output signal to generate a first recovered output signal responsive to said first parametric signal; and

lowpass filtering said second demodulated output signal to generate a second recovered output signal responsive to said second parametric signal.

4. The method as defined in Claim 3, wherein said selected phase difference is π.

5. The method as defined in Claim 3, wherein:

said first pulse and said second pulse are generally rectangular pulses having a duty cycle, and wherein said rectangular pulses comprise a plurality of sinusoidal components including a fundamental component corresponding to said first frequency and a first harmonic component corresponding to said second frequency, said fundamental component having a fundamental component amplitude and said first harmonic component having a first harmonic component amplitude, said first harmonic component amplitude related to said harmonic component amplitude by a first proportionality value; and

said second amplitude of said second component of said first demodulation signal is related to said first amplitude of said first component of said first demodulation signal by a second proportionality value which is approximately the inverse of said first proportionality value.

6. The method as defined in Claim 3, further including the steps of:

sampling said composite signal when neither said first pulse nor said second pulse is active to obtain a sampled signal; and

measuring said sampled signal to determine a noise level of said parametric signals.

7. The method as defined in Claim 3, further including the steps of:

performing a transform on said composite signal to generate a spectra of said composite signal;

sampling said spectra at a plurality of frequencies other than at predetermined ranges of frequencies around said first frequency and around harmonics of said first frequency;

determining an average of the magnitudes of said sampled plurality of frequencies; and

comparing said average to a selected threshold to determine whether the average magnitude exceeds said selected threshold.

8. A method of demodulating a composite signal generated by applying first and second periodic pulses of electromagnetic energy to a system having a parameter to be measured and by receiving signals responsive to said electromagnetic energy after having passed through said system and being affected by said parameter being measured, said signals received as a composite signal having components responsive to said first and second pulses, said method comprising the steps of:

applying a first demodulation signal to said composite signal to generate a first demodulated signal, said first demodulation signal comprising a first component having a first frequency corresponding to a repetition frequency of said first and second pulses and comprising a second component having a frequency which is a harmonic of said first frequency, said first component having a first amplitude and said second component having a second amplitude, said second amplitude having a predetermined relationship to said first amplitude, said predetermined relationship selected to cause said first demodulated signal to have low frequency components responsive only to said first pulse; and

lowpass filtering said first demodulated signal to generate a first output signal, said first output signal varying in response to an effect of said parameter on the electromagnetic energy received from said first pulse.

9. The method as defined in Claim 8, further including the steps of:

applying a second demodulation signal to said composite signal to generate a second demodulated signal, said second demodulation signal having first and second components corresponding to said first and second components of said first demodulation signal, at least one of said first and second components of said second demodulation signal having a selected phase relationship with the corresponding one of said first and second components of said first demodulation signal; and

lowpass filtering said second demodulated signal to generate a second output signal, said second output signal varying in response to an effect of said parameter on the electromagnetic energy received from said second pulse.

10. The method as defined in Claim 9, wherein said selected phase relationship is a π phase difference.

11. A pulse oximetry system, comprising:

a modulation signal generator, said modulation signal generator generating a first modulation signal comprising a first pulse which repeats at a first repetition frequency, said first pulse having a duty cycle of less than 50%, said modulation signal generator generating a second modulation signal comprising a second pulse which also repeats at said first repetition frequency, said second pulse having a duty cycle of less than 50%, said second pulse occurring at non-overlapping times with respect to said first pulse, said first and second pulses comprising a plurality of components wherein a first component has a frequency corresponding to said repetition frequency and a second component has a second frequency corresponding to twice said first frequency, said second component having an amplitude which has a first predetermined relationship to an amplitude of said first component;

a first transmitter which emits electromagnetic energy at a first wavelength in response to said first pulse;

a second transmitter which emits electromagnetic energy at a second wavelength in response to said second pulse;

a detector which receives electromagnetic energy at said first and second wavelengths after passing through a portion of a subject and which generates a detector output signal responsive to the received electromagnetic energy, said detector output signal including a signal component responsive to attenuation of said electromagnetic energy at said first wavelength and a signal component responsive to attenuation of said electromagnetic energy at said second wavelength;

a first demodulator which multiplies said detector signal by a first demodulation signal and generates a first demodulated output signal, said first demodulation signal comprising a first component having said first frequency and

having a first amplitude and comprising a second component having said second frequency and having a second amplitude, said second amplitude having a second predetermined relationship to said first amplitude which second predetermined relationship is inversely proportional to said first predetermined relationship; and

a second demodulator which multiplies said detector signal by a second demodulation signal and generates a second demodulated output signal, said second demodulation signal comprising a first component having said first frequency and having said first amplitude and comprising a second component having said second frequency and having said second amplitude, at least one component of said second demodulation signal having a selected phase relationship with a corresponding one component of said first demodulation signal.

12. The method as defined in Claim 11, wherein said selected phase relationship is a π phase difference.

13. A method of minimizing crosstalk between two signals generated by applying a first pulse and a second pulse to measure a parameter, wherein said first pulse and said second pulse are applied periodically at a first repetition rate defining a period, and wherein said first pulse is generated during a first interval in each period and said second pulse is generated during a second interval in each period, said second interval spaced apart from said first interval, said first and second pulses producing first and second parametric signals responsive to said parameter, said first and second parametric signals being received by a single detector which outputs a composite signal responsive to said first and second parametric signals, said method comprising the steps of:

providing said composite signal to an analog to digital converter to produce a sequence of digital values;

decimating said sequence of digital values to produce a decimated sequence of digital values;

applying a first sequence of demodulation coefficients to said decimated sequence of digital values to generate a first demodulated output signal;

applying a second sequence of demodulation coefficients to said decimated sequence of digital values to generate a second demodulated output signal;

lowpass filtering said first demodulated output signal to generate a first recovered output signal responsive to said first parametric signal; and

lowpass filtering said second demodulated output signal to generate a second recovered output signal responsive to said second parametric signal.

14. The method as defined in Claim 13, further comprising the steps of:

applying a third sequence of demodulation coefficients to said decimated sequence of digital values to generate a third demodulated output signal; and

lowpass filtering said third demodulated output signal to generate a recovered output signal responsive to noise detected by said detector.

15. A method of demodulating a composite signal generated by applying a plurality of periodic pulse trains of electromagnetic energy to a system having a parameter to be measured and by receiving signals responsive to said electromagnetic energy after having passed through said system and being affected by said parameter being measured, said signals received as a composite signal having components responsive to said plurality of periodic pulse trains, each of said components corresponding to one each of said pulse trains, said method comprising the steps of:

sampling said composite signal using an analog to digital converter to produce a sequence of digital values;

decimating said sequence of digital values to produce a decimated sequence of values;

providing said decimated sequence of values to a first input of each of plurality of multipliers;

providing a plurality of sequences of demodulation coefficients to a second input of each of said multipliers such that each multiplier is provided a unique sequence of demodulation coefficients; and

lowpass filtering the output of each of said multipliers such that the output signal of each of said lowpass filters approximately corresponds to one each of said components.

16. A pulse oximetry system, comprising:

a modulation signal generator, said modulation signal generator generating a first modulation signal comprising a first pulse which repeats at a first repetition frequency, said first pulse having a duty cycle of less than 50%, said modulation signal generator generating a second modulation signal comprising a second pulse which also repeats at said first repetition frequency, said second pulse having said duty cycle of less than 50%, said second pulse occurring at non-overlapping times with respect to said first pulse;

a first transmitter which emits electromagnetic energy at a first wavelength in response to said first pulse;

a second transmitter which emits electromagnetic energy at a second wavelength in response to said second pulse;

a detector which receives electromagnetic energy at said first and second wavelengths after passing through a portion of a subject and which generates a detector output signal responsive to the received electromagnetic energy, said detector output signal including a signal component responsive to attenuation of said electromagnetic energy at said first wavelength and a signal component responsive to attenuation of said electromagnetic energy at said second wavelength;

a sampling analog to digital converter which converts said detector output into a sequence of digital values;

a decimator which decimates said sequence of digital values to produce a decimated sequence;

a first demodulator which multiplies said decimated sequence by a demodulation sequence and generates a first demodulated output signal; and

a second demodulator which multiplies said decimated sequence by a second demodulation sequence and generates a second demodulated output signal.

17. The apparatus of claim 16 further comprising a third demodulator which multiplies said decimated sequence by a third demodulation sequence and generates a third demodulated output signal corresponding to noise produced by said detector.

18. The apparatus of claim 16 wherein said decimator has a decimation rate equal to the number of said samples produced during said duty cycle.

19. In a system that includes: a sampling frequency generator generating a sampling frequency f_s; a detector; a modulation signal generator, said modulation signal generator generating a sequence of pulses having a pulse repetition frequency, said pulses having a duty cycle of Q sample periods of said sampling frequency f_s; a transmitter which emits electromagnetic energy at a wavelength in response to said pulse, said detector receiving said electromagnetic energy to generate a detector output signal responsive to the received electromagnetic energy, said detector output signal including noise caused by ambient electromagnetic energy detected by said detector; a digital to analog converter which produces digital samples of said detector output signal at said sampling frequency; and a demodulator which demodulates said digital samples to produce a desired output signal, a method for minimizing said noise due to ambient electromagnetic energy in said desired output signal comprising the steps of:

identifying all undesired frequency components of said ambient electromagnetic energy detected by said detector;

using said undesired frequency components to compute a set of acceptable modulation cycle times T; and

using said acceptable modulation cycle times to select said f_s and said Q using an equation $T=4Q/f_s$.

20. A method for demodulating a multi-channel composite signal comprising the acts of:

generating a demodulation sequence for a selected channel;

providing said demodulation sequence to a first input of a demodulator;

providing a sampled composite signal to a second input of said demodulator.

21. The method of Claim 20, further comprising the act of decimating an output of said demodulator by a decimation factor R.

22. The method of Claim 21, wherein said act of decimating includes the acts of:

lowpass filtering; and

sample rate compressing.

23. The method of Claim 20, further comprising the act of decimating said sampled composite signal before providing said sampled composite signal to said second input of said demodulator.

24. The method of Claim 23, wherein said act of decimating includes the acts of lowpass filtering and sample rate compressing.

25. The method of Claim 24, wherein said acts of lowpass filtering and sample rate compressing are controlled by an adaptive algorithm.

26. The method of Claim 20, further comprising the acts of:

decimating in a first decimator said sampled composite signal before providing said sampled composite signal to said second input of said demodulator, wherein said first decimator has a first lowpass filter transfer function and a first decimation rate; and

decimating in a second decimator an output of said demodulator, wherein said second decimator has a second lowpass filter transfer function and a second decimation rate.

27. The method of Claim 26, further comprising the act of controlling said first lowpass filter, said second lowpass filter, said first decimation rate, and said second decimation rate by an adaptive algorithm.

28. The method of Claim 26, wherein a product of said first decimation rate and said second decimation rate is substantially constant.